

dummy wafers and the confusion of the dummy wafers having small numbers of times of use with the dummy wafers having large numbers of times of use. For these reasons, the dummy wafers can be used effectively without any problem when plasma cleaning is carried out.

Furthermore, in accordance with the present invention, the apparatus can have a plurality of processing chambers and can transfer wafers and dummy wafers by the same conveyor. Since plasma cleaning can be carried out by managing the timing of cleaning of each processing chamber by the controller, the cleaning cycle can be set arbitrarily, dry cleaning can be carried out without interrupting the flow of the processing, the processing can be efficiently made and the productivity can be improved.

As described above, according to the present invention, there are effects that the construction of the apparatus is simple, the substrates to be processed are free from contamination and the production yield is high.

What is claimed is:

1. A method of using a conveyor system for processing substrates in plural vacuum processing chamber installation portions, the conveyor system including:

an atmospheric loader, having a location for positioning at least one cassette containing the substrates, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber, having an atmospheric loader side and a vacuum loader side, and having a gate valve for said atmospheric loader side and another gate valve for said vacuum loader side,

wherein said vacuum loader has

(1) a transfer chamber connected to the lock chamber via the another gate valve, the method comprising the steps of:

transferring substrates, to be processed, from a cassette at said location of said atmospheric loader, to said lock chamber;

after transferring substrates to the lock chamber, providing a vacuum in said lock chamber;

after providing a vacuum in said lock chamber, transferring substrates to be processed, from said lock chamber to said transfer chamber;

thereafter, transferring processed substrates from said transfer chamber to said lock chamber; and

transferring processed substrates from said lock chamber to said atmospheric loader from which the substrates had been transferred to the lock chamber.

wherein said gate valve and said another gate valve are opened and closed every carrying-in of a substrate, to be processed, to the lock chamber, and every carry-out a processed substrate from the lock chamber.

2. A method of transferring at least one wafer in a vacuum processing apparatus, comprising the steps of:

(i) placing a cassette containing at least one wafer to be processed, at a cassette table, the cassette table having an upper region thereover which is open to a cassette transferring path;

(ii) loading said at least one wafer sequentially in order from said cassette, by means of a first conveyor, to a load lock chamber, in which one wafer is to be disposed and therefrom, by means of a second conveyor, to a transfer chamber under vacuum; and

(iii) after processing the wafers, unloading processed wafers from a plurality of vacuum processing chambers

into said cassette at said cassette table, from which the wafers had been loaded, by means of the second conveyor in said transfer chamber under vacuum, an unload lock chamber, in which one wafer is to be disposed, and said first conveyor.

3. A method of transferring cassettes in operating a vacuum processing apparatus having plural vacuum processing chambers, the vacuum processing apparatus including:

an atmospheric loader, having a location for positioning at least one cassette containing samples, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber for connecting said atmospheric loader and said vacuum loader, said lock chamber having opening and closing devices for carry-in samples to be processed in the vacuum processing chambers into the lock chamber and for carry-out processed samples from the lock chamber, wherein

said atmospheric loader includes a cassette mount unit located in front of said lock chamber, and

said cassette mount unit has a cassette positioning plane in which all cassettes, containing the samples to be processed, are positioned in front of a front wall of said lock chamber, said cassette positioning plane being at said location,

the method comprising a step of:

placing said cassette on and removing said cassette from said cassette mount unit which is in front of said lock chamber while maintaining a surface of the samples substantially horizontal,

wherein the opening and closing devices of the lock chamber are opened and closed every carrying-in of a sample, to be processed, to the lock chamber, and every carrying-out of a processed sample from the lock chamber.

4. The method according to claim 3, wherein said cassette is one of a plurality of cassettes positioned in a single row in front of said lock chamber.

5. A method of transferring cassettes in operating a vacuum processing apparatus, the vacuum processing apparatus including:

an atmospheric loader, having a location for positioning at least one cassette containing samples, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber for connecting said atmospheric loader and said vacuum loader, wherein

said atmospheric loader includes a cassette mount unit located in front of said lock chamber, and

said cassette mount unit has a cassette positioning plane in which cassettes, containing samples to be processed, are positioned in front of a front wall of said lock chamber, said cassette positioning plane being at said location, and

an automatic cassette loader for loading cassettes into the atmospheric loader,

the method comprising a step of:

placing said cassette on and removing said cassette from said cassette positioning plane of said cassette mount unit by said automatic cassette loader, in accordance with data sent from a host control apparatus.

6. The method according to claim 5, wherein said cassette positioning plane is a plane in which all cassettes, to be

positioned in front of the front wall of the lock chamber, are positioned in a single row in front of said front wall.

7. A method of operating a vacuum processing apparatus, the vacuum processing apparatus including:

an atmospheric loader, having a location for positioning at least one cassette containing samples, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber for connecting said atmospheric loader and said vacuum loader, wherein

said atmospheric loader includes a cassette mount unit located in front of said lock chamber,

said cassette mount unit has a cassette positioning plane in which all cassettes, containing samples to be processed, are positioned in front of a front wall of said lock chamber, said cassette positioning plane being at said location, and

an automatic cassette loader for loading cassettes into the atmospheric loader,

the method comprising the steps of:

placing said cassette on said cassette positioning plane, in front of said lock chamber, and removing said cassette, by said automatic cassette loader in accordance with data sent from a host control apparatus; and

automatically executing a sample processing in said vacuum processing apparatus, based on processing data.

8. The method according to claim 7, wherein said cassette positioning plane is a plane in which all cassettes, to be positioned in front of the front wall of the lock chamber, are positioned in a single row in front of said front wall.

9. A method of operating a vacuum processing apparatus, the vacuum processing apparatus including:

an atmospheric loader, having a location for positioning at least one cassette containing samples, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber for connecting said atmospheric loader and said vacuum loader, said lock chamber having opening and closing devices for carry-in samples, to be processed, into the lock chamber and for carrying-out processed samples from the lock chamber, wherein

said atmospheric loader includes a cassette mount unit located outside of said lock chamber, and

said cassette mount unit has a cassette positioning plane in which all cassettes, containing samples to be processed, are positioned in front of a front wall of said lock chamber, said cassette positioning plane being at said location,

wherein the method comprises the steps of:

carrying in a sample, disposed under atmospheric pressure, from a cassette, at said location in said cassette positioning plane, positioned in front of the front wall of said lock chamber, into at least one of a plurality of vacuum processing chambers of said vacuum processing apparatus, using said lock chamber;

processing said sample in said at least one vacuum processing chamber; and

carrying out said sample, processed in said at least one vacuum processing chamber, into said atmospheric pressure, using said lock chamber.

wherein the opening and closing devices of the lock chamber are opened and closed every carry-in of a sample, to be processed, to the lock chamber, and every carrying-out of the processed sample from the lock chamber.

10. The method according to claim 9, wherein said cassette positioning plane is a plane in which all of the cassettes are positioned in a single row in front of the front wall of the lock chamber.

11. A method of operating a vacuum processing apparatus, the vacuum processing apparatus including:

an atmospheric loader, having a location for positioning at least one cassette containing samples, the location having an upper region which is open to a cassette transferring path;

a vacuum loader; and

a lock chamber for connecting said atmospheric loader and said vacuum loader, said lock chamber having opening and closing devices for carry-in samples, to be processed, into the lock chamber and for carry-out processed samples from the lock chamber, wherein

said atmospheric loader includes a cassette mount unit located outside of said lock chamber, and

said cassette mount unit has a cassette positioning plane in which all cassettes, containing samples to be processed, are positioned in front of a front wall of said lock chamber, said cassette positioning plane being at said location,

wherein the method comprises the steps of:

carrying in a sample, disposed in an atmosphere different than an atmosphere in a plurality of vacuum processing chambers, from a cassette positioned in front of the front wall of the lock chamber, at said location, into at least one of said vacuum processing chambers, using said lock chamber;

processing said sample in said at least one vacuum processing chamber; and

carrying out said sample, processed in said at least one vacuum processing chamber, into said atmosphere different from the atmosphere in said at least one vacuum processing chamber, using said lock chamber.

wherein the opening and closing devices of the lock chamber are opened and closed every carry-in of a sample, to be processed, to the lock chamber, and every carrying-out of a processed sample from the lock chamber.

12. The method according to claim 11, wherein said cassette positioning plane is a plane in which all of the cassettes are positioned in a single row in front of the front wall of the lock chamber.

13. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in front of a front wall of a lock chamber, on a cassette table, the cassette table having an upper region thereover which is open to a cassette transferring path, said lock chamber having opening and closing devices for carry-in samples, to be processed, into the lock chamber and for carry-out processed samples from the lock chamber;

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using the lock chamber;

processing said sample in said vacuum processing chamber;

US 6,330,755 B1

11

carrying out said sample, processed in said vacuum processing chamber, to said cassette, using said lock chamber; and

removing said cassette from the cassette table,

wherein the opening and closing devices of the lock chamber are opened and closed every carrying-in of a sample, to be processed, to the lock chamber, and every carry-out of a processed sample from the lock chamber.

14. The method according to claim 13, wherein the cassette is placed at a position in a single row in front of the front wall of the lock chamber.

15. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, on a cassette table, the cassette table having an upper region thereover which is open to a cassette transferring path;

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using a lock chamber, in which one sample is to be disposed;

processing said sample in said vacuum processing chamber;

carrying out said sample, processed in said vacuum processing chamber, to said cassette which had contained the sample prior to carrying the sample into the vacuum processing chamber, using said lock chamber; in which one sample is to be disposed; and

removing said cassette from the cassette table.

16. A method of treating a sample in at least one of plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in a single row in front of a front wall of a lock chamber, on a cassette table, the cassette table having an upper region thereover which is open to a cassette transferring path, said lock chamber having opening and closing devices for carry-in samples, to be processed, into the lock chamber and for carry-out processed samples from the lock chamber;

carrying in the sample into a vacuum processing chamber, of said plural vacuum processing chambers, using the lock

chamber, processing said sample in said vacuum processing chamber; and

carrying out said sample, processed in said vacuum processing chamber, using said lock chamber,

wherein the opening and closing devices of the lock chamber are opened and closed every carrying-in of a sample, to be processed, to the lock chamber, and every carrying-out of the processed sample from the lock chamber

17. A method of treating a semiconductor wafer in plural vacuum processing chambers, comprising the steps of:

placing a wafer storing structure, containing the semiconductor wafer, at a position in front of a front wall of a lock chamber, on a wafer storing structure table, the wafer storing structure table having an upper region thereover which is open to a wafer storing structure transferring path;

carrying in the semiconductor wafer into a vacuum processing chamber, of the plural vacuum processing chambers, using a lock chamber, in which one semiconductor wafer is to be disposed;

processing said semiconductor wafer in said vacuum processing chamber; and

carrying out said semiconductor wafer, processed in said vacuum processing chamber, to said wafer storing

12

structure which had contained the semiconductor wafer prior to carrying the semiconductor wafer into the vacuum processing chamber, using said lock chamber, in which one semiconductor wafer is to be disposed.

18. The method according to claim 17, wherein the wafer storing structure is placed at a position in a single row in front of the front wall of the lock chamber.

19. A method of treating a semiconductor wafer in plural vacuum processing chambers, comprising the steps of:

placing a wafer storing structure, containing the semiconductor wafer, at a position in front of a front wall of a lock chamber, on a wafer storing structure table, the wafer storing structure table having an upper region thereover which is open to a wafer storing structure transferring path;

carrying in the semiconductor wafer into a vacuum processing chamber, of the plural vacuum processing chambers, using the lock chamber;

processing said semiconductor wafer in said vacuum processing chamber; and

carrying out said semiconductor wafer, processed in said vacuum processing chamber, to said wafer storing structure which had contained the semiconductor wafer prior to carrying the semiconductor wafer into the vacuum processing chamber, using said lock chamber, in which one semiconductor wafer is to be disposed.

20. The method according to claim 19, wherein the wafer storing structure is placed at a position in a single row in front of the front wall of the lock chamber.

21. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in front of a front wall of a lock chamber, on a cassette table, the cassette being set at a position where an upper region thereof is open to a wafer storing structure transferring path;

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using the lock chamber, in which one sample is to be disposed, wherein the sample is carried directly from the cassette to the lock chamber;

processing said sample in said vacuum processing chamber; and

carrying out said sample, processed in said vacuum processing chamber, to said cassette which had contained the sample prior to carrying the sample into the vacuum processing chamber, using said lock chamber, in which one sample is to be disposed.

22. The method according to claim 21, wherein said cassette is placed at a position in a single row in front of the front wall of the lock chamber.

23. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in front of a front wall of a lock chamber, on a cassette table, the cassette being set at a position where an upper region thereof is open to a cassette transferring path;

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using the lock chamber, in which one sample is to be disposed, wherein the sample is carried directly from the cassette to the lock chamber, samples being transferred from the cassette to the lock chamber;

processing said sample in said vacuum processing chamber; and

13

carrying out said sample, processed in said vacuum processing chamber, to said cassette from which the sample had been carried into the vacuum processing chamber, using said lock chamber, in which one sample is to be disposed.

24. The method according to claim 23 wherein said cassette is placed at a position in a single row in front of the front wall of the lock chamber.

25. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in a row in front of a front wall of a lock chamber, on a cassette table, disposed at a position where an upper region thereof is open to a cassette transferring path, said lock chamber having opening and closing devices for carry-in samples, to be processed, into the lock chamber and for carry-out processed samples from the lock chamber;

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using the lock chamber, whereby the sample is carried into the lock chamber from the cassette;

processing said sample in said vacuum processing chamber; and

carrying out said sample, processed in said vacuum processing chamber, using said lock chamber, whereby the sample is carried out from the lock chamber to the cassette,

wherein the sample is carried from the cassette to the lock chamber in a direction opposite to the direction in which the sample is carried out from the lock chamber to the cassette.

wherein the opening and closing devices of the lock chamber are opened and closed every carry-in of the sample, to be processed, to the lock chamber, and every carrying-out of the processed sample from the lock chamber.

26. A method of treating a sample in plural vacuum processing chambers, comprising the steps of:

placing a cassette, containing the sample, at a position in a row in front of load and unload lock chambers, the load and unload lock chambers being separate chambers, the cassette being placed on a cassette table, disposed at a position where an upper region thereof is open to a cassette transferring path, each of the load and unload lock chambers having opening and closing devices for carry-in a sample to be processed in a vacuum processing chamber to the load lock chamber and for carry-out a processed sample from the unload lock chamber.

carrying in the sample into a vacuum processing chamber, of the plural vacuum processing chambers, using the load lock chamber;

processing said sample in said vacuum processing chamber; and

carrying out said sample, processed in said vacuum processing chamber, using said unload lock chamber, wherein the opening and closing devices of the load lock chamber are opened and closed every carrying-in of a sample, to be processed, to the load lock chamber, and every carry-out of a processed sample from the unload lock chamber.

27. A transfer method in operating a vacuum processing apparatus, the vacuum processing apparatus including:

a transfer chamber connected to plural vacuum processing chambers in which substrates to be processed are vacuum processed one-by-one;

14

a cassette table for mounting a cassette which receives plural substrates to be processed or substrates having been processed, said cassette being mounted to a position where an upper region thereof is open to a cassette transferring path;

a load lock chamber and an unload lock chamber, for carrying in and carrying out said substrates to be processed or said substrates having been processed, from and to said cassette, mounted at said position, and for carrying in and carrying out said substrates to be processed or said substrates having been processed, from and to any of said vacuum processing chambers through said transfer chamber;

one atmospheric transfer apparatus for transferring said substrates to be processed or said substrates having been processed between said cassette mounted at said position and said load lock chamber and said unload lock chamber; and

gate valves provided respectively at an atmospheric side and a vacuum side of said load lock chamber and said unload lock chamber and for opening and closing at every carry-in and carry-out time of said substrates to be processed or said substrates having been processed so as to change over said load lock chamber and said unload lock chamber in an atmospheric atmosphere or a vacuum atmosphere;

wherein the transfer method comprises:

carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said unload lock chamber at said atmospheric atmosphere and said cassette mounted at said position.

28. The transfer method according to claim 27, including the further step of carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said unload lock chamber in the vacuum atmosphere and said cassette mounted at said position.

29. The transfer method according to claim 27, including the further step of carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said unload lock chamber in the vacuum atmosphere and the transfer chamber in the vacuum atmosphere.

30. A transfer method in operating a vacuum processing apparatus, the vacuum processing apparatus including:

a transfer chamber connected to plural vacuum processing chambers in which substrates to be processed are vacuum processed one-by-one;

a cassette table for mounting a cassette which receives plural substrates to be processed or substrates having been processed, the cassette being mounted at a position where an upper region thereof is open to a cassette transferring path;

a load lock chamber for carrying in said substrates to be processed from said cassette mounted at said position and for carrying out said substrates to be processed to any of said vacuum processing chambers through said transfer chamber;

an unload lock chamber for carrying in said substrates having been processed from any of said vacuum processing chambers through said transfer chamber and for carrying out said substrates having been processed to said cassette mounted at said position;

one atmospheric transfer apparatus for transferring said substrates to be processed or said substrates having

15

been processed between said cassette mounted at said position and said load lock chamber and said unload lock chamber; and

gate valves provided respectively at an atmospheric side and a vacuum side of said load lock chamber and said unload lock chamber and for opening and closing at every carry-in and carry-out time of said substrates to be processed or said substrates having been processed so as to change over said load lock chamber or said unload lock chamber in an atmospheric atmosphere or a vacuum atmosphere,

wherein the transfer method comprises:

carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said

16

unload lock chamber in the atmospheric atmosphere and said cassette mounted at said position.

31. The transfer method according to claim 30, including the further step of carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said unload lock chamber in the vacuum atmosphere and said cassette mounted at said position.

32. The transfer method according to claim 30, including the further step of carrying in and carrying out said substrates to be processed or said substrates having been processed, one-by-one, between said load lock chamber or said unload lock chamber in the vacuum atmosphere and the transfer chamber in the vacuum atmosphere.

* * * * *